

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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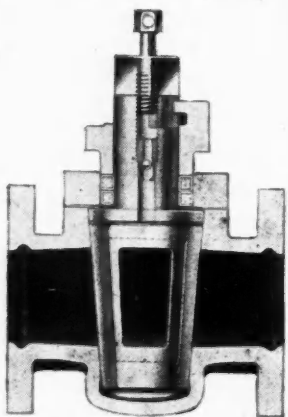
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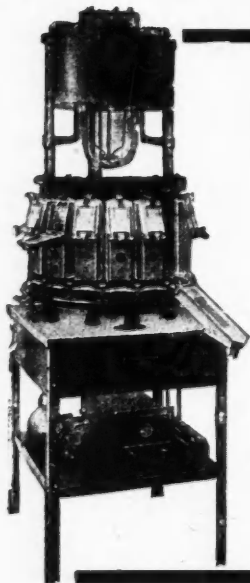
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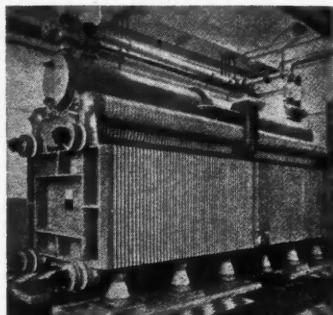
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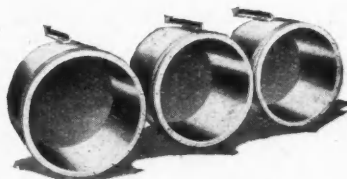
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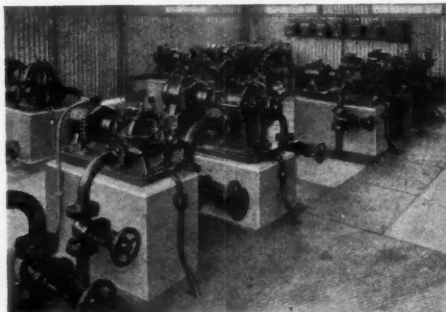


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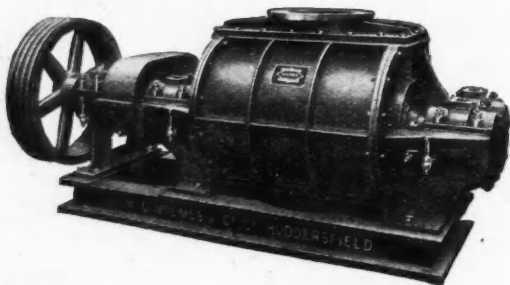
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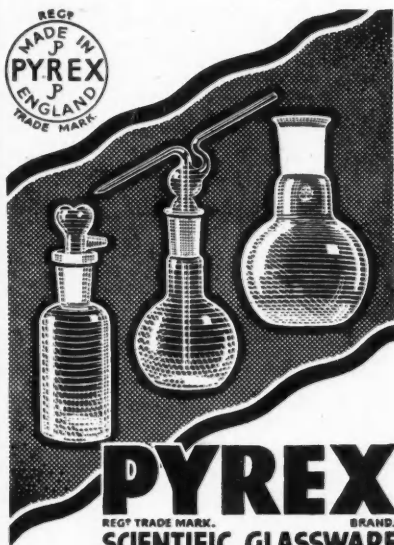
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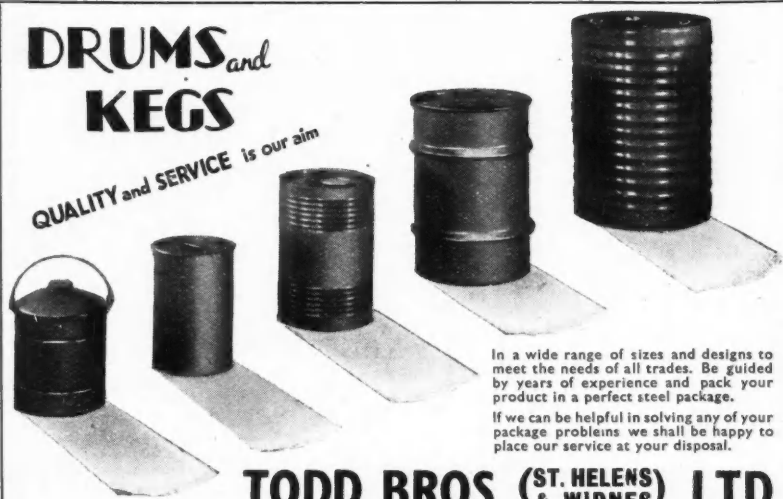
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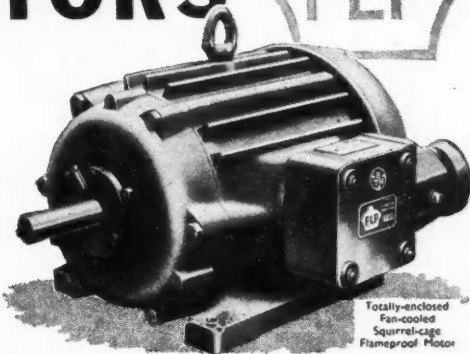
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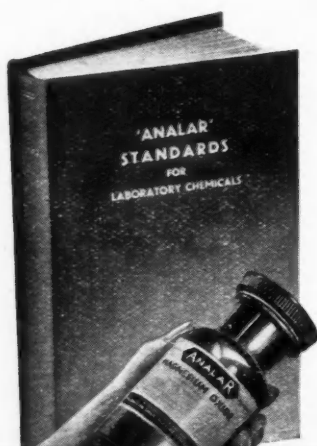
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Atmospheric Corrosion

WORK on corrosion has emphasised how our ideas regarding natural phenomena change. We have always maintained that a very great deal of useful work can be done with simple apparatus and using comparatively elementary methods; much of the early experimental work which established fundamental facts that are still regarded as correct was done in this way. But the fact remains that the conclusions reached by this more elementary type of research are not infrequently changed by later investigations carried out by the elaborate and highly scientific methods of modern experimental science. Thus in the course of recorded history we have travelled from the vague suppositions of the ancient philosophers (the elder Pliny regarded the tendency of iron to rust as a punishment inflicted by nature in retribution for the war-like uses to which the metal had been put by man), through the simple explanations of scientific phenomena adduced by the early practitioners of experimental investigation—explanations sometimes found later to be erroneous—to the often highly complex deductions of modern scientists. Whether these modern explanations will stand the test of time we do not yet know.

The Jubilee Memorial lecture given by Dr. W. H. J. Vernon to the Society of Chemical Industry on "The Corrosion of Metals in Air," is an excellent example of the trend of scientific thought. Not so many years ago the atmospheric corrosion of ferrous metals was regarded as being due to the combined action of air, water and carbon dioxide, the two latter substances in combination acting as the essential acid that set up corrosion through the formation of ferrous bicarbonate, which was then converted by hydrolysis and oxidation into ferric hydroxide. Not only has modern research not supported this view, but, according to Dr. Vernon, has shown that atmospheric carbon dioxide has a marked repressive effect; the part of the villain in the piece is instead played by sulphur

dioxide, a fact of extreme importance to the would-be reformers of our atmosphere. To that we propose to return later.

Corrosion effects are to-day looked upon as being primarily governed by surface films, both as regards mechanism of attack and rate of attack. The corrosion may involve the progressive formation of a film of corrosion product, or it may be due to the progressive breakdown of a protective film initially

On Other Pages

Notes and Comments	229
Notes on Poison Gases	231
Personal Notes	234
New Control Orders	234

METALLURGICAL SECTION.

Applied Electrostatic Separation	235
Welding Aluminium Alloys	239
Acid-resisting Metal	240
Magnesium Compounds in America	241
South American Rotenone	243
Manganese from Low-grade Ores	244
Electronic Welding	244
General News from Week to Week	245
Commercial Intelligence	246
Company News	247
Stocks and Shares	247
British Chemical Prices	248

present on the metal. To put the matter into summarised form it is worth following Dr. Vernon's explanation. The rate of attack is first governed by certain "controlling factors," which will be different in different conditions; for instance, a metal immersed in water can only receive oxygen by diffusion through the water, and the rate at which the oxygen can reach the metal surface may be the controlling factor; on the other hand, the same metal in air is immersed in oxygen and the controlling factor may be the amount of water vapour in the air. In atmospheric corrosion the outstanding promoting factors are the very small amounts present of sulphurous impurities derived from combustion, namely, hydrogen sulphide and sulphur dioxide, the latter being mainly responsible under open-air conditions.

Four types of corrosion have been noted as being due to the formation of films. These are explained by the formation of two films on metal surfaces, the inner one being continuous and the outer one granular. When the time-weight increase graph is a straight line, the rate of corrosion is governed by diffusion through the inner film, the resistance of the outer film being negligible (*e.g.*, oxidation of zinc at lower temperatures). When the resistance of the outer film is not negligible, the graph takes the form of a logarithmic curve (*e.g.*, oxidation of zinc at 400° C.). If the resistance of the outer film is higher still, the rate of oxidation is governed by diffusion through the two films in series and the curve is parabolic (*e.g.*, atmospheric corrosion of copper). Finally, the curve may be asymptotic, flattening rapidly towards the time-axis so that the rate of oxidation becomes negligible (*e.g.*, oxidation of aluminium and lead at room temperatures), and here the resistance of the films evidently becomes so high that they are protective in character.

The rusting of iron is in a different category, because here the action involves not film-formation, but film-break-down. There is evidence that iron initially possesses a protective film, and that this film can be broken down by the deposition on it of solid particles which act as centres from which rusting proceeds. Dr. Vernon has described an interesting experiment in which iron screened from solid particles by a muslin

cage did not rust, whereas a similar specimen outside the cage rusted freely. The amount of moisture in the atmosphere is important since attack on the metal does not appear to start until a humidity of some 50-60 per cent. is reached, and a great acceleration occurs at 70 per cent. relative humidity. A very important observation is that charcoal particles appear to have a particularly great accelerating effect on rusting. Sulphur dioxide, as has been mentioned previously, is the primary destructive agent. In absence of this gas only small weight increases are recorded. Rusting occurs in presence of traces of sulphur dioxide even when solid particles are absent, but the rate is slightly accelerated by silica particles, considerably accelerated by ammonium sulphate particles, and very greatly accelerated by charcoal particles. Obviously, the acceleration is due to the surface condition of the particle, so that those with a large surface area for the absorption of water vapour and sulphur dioxide will have the greater effect. It is evident, therefore, that the problem of arresting atmospheric corrosion is closely linked with the elimination of sulphur dioxide from the atmosphere. Coal and coke both contain sulphur which is the primary source of sulphur dioxide—coal being a greater offender than coke.

The basic problem from the point of view of the user of metals is how to form a protective film. However deeply scientific theory may go in its explanations of the mechanism of corrosion, it appears that both now and for a long time to come the best protective film will be paint properly applied. What has been shown has been the value of proper preparation of the surface and we confidently predict that as time goes on more and more engineers will look to pickling as the prime measure, followed by immediate painting. When this has been done—and it must be done at the steel-works or the engineering works where the plant is manufactured—the battle is half won. It remains only for the works engineer to maintain his coat of paint in good condition. The scientific theory of rusting is only one-half of the story, as Dr. Vernon agreed. The other half is being written by experimental outdoor tests, such as those carried out by the Corrosion Committee of the Iron and Steel Institute.

NOTES AND COMMENTS

River Pollution

CHEMISTS of one kind or another are largely responsible both for the pollution and for the purification of rivers, and it is, in the main, the circumstances of the time which are the deciding factor in the fight for riverine amenities. We published recently an announcement concerning the White Paper of the Central Advisory Water Committee on this subject, and now no less an authority than Mr. S. Pearson, the chief engineer of the Rivers Mersey and Irwell Catchment Board, has entered the lists, with a letter to the *Manchester Guardian*. With such rivers under his eye, Mr. Pearson should know all that there is to be known about pollution, and in addition he has 30 years' experience of rivers in Canada, India, and Europe. As a result, his opinion of our treatment of rivers in this country is not complimentary. "Pounced upon at birth, diverted, polluted, abused, and prostituted from source to mouth"—that is his description of our rivers—and, as he says further, mostly for private gain. In war-time it is excusable if the pollution of rivers is not regarded as an evil demanding immediate redress; but it is an evil none the less, and it is to be hoped that the Water Committee will see that proper treatment is meted out to our rivers as part of the post-war planning programme. The prevention of pollution is no longer within the province of catchment boards; the Rivers Boards and their chemists are now responsible; and when the Ministry of Health can overrule the Ministry of Production in this connection their work will begin in earnest. Meanwhile, it is well that this problem should not be forgotten. We have lost ground owing to the exigencies of war; let there be no delay in making it up again as soon as opportunity offers.

Artificial Fertilisers

WE are glad to see that our contemporary, *The Fertiliser Journal*, has taken upon itself the task of destroying the false premises on which the publicists of humus, and the lovers of dung and compost, base their attacks against the use of artificial fertilisers. To prove their case they have chosen to ignore all the work that has been done in the last hundred years by plant physiologists,

and by horticultural and agricultural research workers. They ignore, for instance, the water-culture experiments done by Sach and his successors, which proved, as long ago as the middle of last century, that plants could be made to pass through their life-cycles without receiving any organic matter from the soil. They have forgotten, too, the researches of men like Sir Daniel Hall and Sir John Russell at Rothamsted, as well as the experience of countless farmers who have raised not merely good crops, but better crops, by spreading artificials on their fields. The author of the article in *The Fertiliser Journal* is probably right in blaming Sir Albert Howard's book "Agricultural Testament" for the birth of the anti-chemical-manure school. Unfortunately, those who preach Howard's queer theories of plant physiology are not without some influence. There is, for instance, the agricultural correspondent of the *News Chronicle* who recently endeavoured to prove that there was no need at all to use artificial fertilisers. Shades of the principle of the Conservation of Matter!

The Broken Cycle

PLANTS derive their carbon, hydrogen, and oxygen from the air; the other elements have to come from the soil, so that the only way to maintain full fertility without using artificials is to return to the soil the entire crop that has been raised, either by ploughing it in, feeding it all to animals and letting it go back as manure, or converting it into compost. The logical conclusion of the humus fanatics' arguments is that the human race must starve; if it eats some of the crops that have been raised, then only artificials can make good that deficit. In theory there is a natural cycle whereby all the elements which plants fix from the air or the soil are made available once more by bacteria of decay, but Sir Albert Howard and his followers do not appear to realise that man has broken that cycle, and that the fractured ends cannot be welded together again without a revolution in our methods of sewage disposal. Until that is achieved, good husbandry will need to be reinforced by liberal dressings of artificials. Other-

wise farmers will be unable to feed the world's millions of inhabitants.

An Austrian Ploesti

RUMANIAN oil production is not what it was. The yearly production at Ploesti, the country's chief producing and refining centre, fell from 7.15 million tons in 1937 to somewhere between 5.5 and 5.75 million tons in 1942. How far the air offensive will further reduce the 1943 output cannot yet be estimated, as there is no reason to suppose that last month's brilliant aerial attack was an isolated phenomenon, although it caused heavy damage to 13 of the refineries at Ploesti, which were of the highest importance to the German war machine. Owing to the large oil reserves that the Nazis still seem to have at their disposal, the loss of the Rumanian refineries may not be felt at once, but the violent fighting in Sicily and the Ukraine must have made deep inroads into the reserve, and a substitute for the Ploesti oil will have to be found somewhere. At the moment the Nazis are most likely looking towards a small Austrian town, named Zistersdorf, some 20 miles N.E. of Vienna. Austrians were surprised, a decade or so ago, when it was announced that a geologist, Dr. Buergl, had found petroleum at Zistersdorf, and that 30,000 tons a year would be produced. At the time of Hitler's march into Austria, this figure had been doubled, and since then, under German management, the yearly output rose to over 300,000 tons, and is now estimated at something approaching 750,000, or 15 per cent. of the German need for natural oil. The surprise raid on Wiener-Neustadt, about 20 miles south of Vienna, will have removed any complacency as to the immunity of Zistersdorf from aerial attack. Yet one more source of the life-blood of modern German warfare is in jeopardy, and "oil from Austria" may soon be a thing of the past.

Penicillin

IN its early stages a new drug can be an embarrassment almost to the medical profession. That is happening with penicillin since the demands for it so far exceed the supplies. The newspapers have led the public to expect great things of this "wonder drug," and its potency as a bacteriostatic agent has not been

exactly understated by the medical profession. Indeed, it seems to us that some doctors have been guilty of an error of judgment in telling their patients that some diseases—osteomyelitis, for instance—can be cured by penicillin, and *only* by penicillin, for such patients are led to believe that they are doomed unless they can obtain it. Individual civilian patients cannot, in fact, be treated with penicillin yet, owing to the needs of the fighting services. That point is made clear in the current number of the *British Medical Journal*. Doctors should take notice of that paper's authoritative statement about penicillin supplies and act accordingly, by doing nothing to add to the number of those people who are now under the impression that unless they are treated with penicillin they are bound to die. Our colleagues of the lay Press, too, would be doing a public service if they chose their words very carefully and avoided raising false hopes and false fears when writing about penicillin.

Trade Union Scientists

NEXT week the T.U.C. holds its annual conference. The Association of Scientific Workers are sending two delegates, this year being the second occasion on which scientists will be represented at the most important trade union meeting of the year. The Association has tabled two resolutions which will be discussed at the conference. The first deals with technical education, and is framed in words that will be endorsed not only by other scientific organisations, but by progressive employers everywhere. It asks that all reasonable facilities be given to young employees for study and technical school training during their employers' time and without loss of pay, and it further proposes that proper wage scales on a wage-for-age basis be paid to all young employees, with increases for educational attainments so that there is definite encouragement for them to continue their education. The other resolution welcomes the growth of trade union organisation among all sections of non-manual workers, but expresses concern at the opposition of certain employers and employing authorities to the right of their non-manual technical and scientific staffs to be represented by *bona-fide* unions.

Notes on Poison Gases

II—Physical Properties

by W. J. G. DAVEY, B.Sc.

THE physical properties of chemical compounds play an important rôle in their use as poison gases. It is essential, for example, that the gases should be heavier than air, and the lightness of hydrocyanic acid vapours and carbon monoxide, for example, renders these toxic gases unsuitable for chemical warfare. The vapour pressure, which determines volatility and persistence of the liquid compounds, requires careful consideration.

Vapour pressure, which is, of course, closely allied with boiling point, is of particular importance in two directions. In the first place it determines the so-called "volatility" or saturation concentration of the gas, i.e., the maximum concentration of vapour which it is possible to obtain under given climatic conditions; and in the second place, it governs the "persistence" of the gas, which may be roughly defined as the time during which it remains effective.

The volatility, which may be expressed as the weight (mgm.) of substance which saturates 1 cubic metre of air at the temperature under consideration (or alternatively as parts per million), is obtained by calculation as follows: If the vapour pressure of the substance is p mm. Hg. at a given temperature $t^{\circ}\text{C.}$, then $p/760$ c.c. of vapour saturates 1 c.c. of air, and $10^6/760$ c.c. of vapour saturates 1 cu. m. of air (= parts per million). Or, since the vapour density of the substance, assuming it to be

a perfect gas, is $\frac{M}{273} \times \frac{273+t}{273}$ gms./litre, or mgms./c.c., the saturation concentration is $10^6 p \times \frac{M}{22.4} \times \frac{273}{273+t}$ mgms./cu.m. (M

being the molecular weight). The volatility is, naturally, of considerable importance in connection with liquids used as lethal war gases, since it is obviously essential that the concentrations obtainable under ordinary conditions should be sufficiently high to be rapidly effective.*

The volatility at 20°C. , i.e., at average climatic temperature, may be calculated from the formula (where y represents volatility):—

$$y = \frac{10^6 p}{760} \times \frac{M}{22.4} \times \frac{273}{273+t} \dots\dots (1)$$

$$= 54.74 p M \dots\dots (2)$$

In the above quotation it is stated that vapour pressure is closely allied with boiling

point. This is shown in Fig. 1, in which the logs. of boiling points (absolute temperatures) are plotted against the logs. of the vapour pressures, for the commoner war gases.

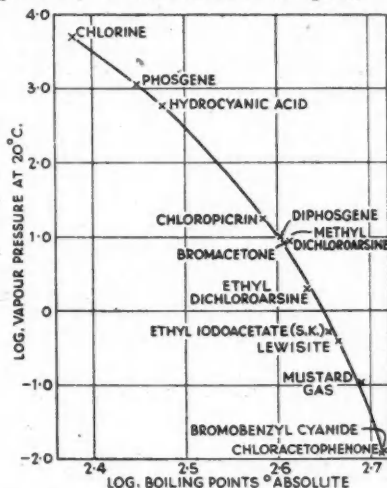


Fig. 1.

The relation has been expressed in an empirical formula

$$\frac{5.37 B_k}{T_k} = 8.255 - \log V \dots\dots (3)$$

where B_k is the boiling point in $^{\circ}\text{Abs.}$, T_k is the temperature in $^{\circ}\text{Abs.}$

and V is the vapour pressure at the temperature T_k .

For a temperature of 20°C. (293°Abs.) this becomes

$$\log V = 8.255 - 0.01892 B_k \dots\dots (4)$$

In Fig. 2 the boiling points are plotted against the logs. of the vapour pressure at 20°C. , the straight line representing the formula $\log V = 8.255 - 0.01892 B_k$, and it will be noticed that there is some agreement between the positions of the various points and the straight line.

The physical properties of typical war gases are shown in Table I, in column 7 of which the vapour pressures have been calculated from formula (4) and may be compared with the determined results in column 6. The volatilities in column 8 have been calculated from the vapour pressures in column 6, making use of formula (2).

The persistence of a gas, i.e., the time

* Detection and Identification of War Gases (A.R.P. Brochure), p.3.

TABLE 1.—Physical Properties of Typical War Gases

	Sp. Gr. Water = 1	Vapour Density Air = 1	Molecular Weight	M.P.°C.	B.P.°C.	Vapour Pressure Determined at 20°C.		Volatility mgm./litre at 20°C.	Relative Persistence Water = 1	Persistence in Hours		
						mm. Hg.	mm. Hg.			Summer In open	In woods	Winter In open
Chlorine ...	1.41	2.5	70.9	-102	-33.6	5031	7031	19,370	0.002	.08	.33	.17
Phosgene ...	1.38	2.5	98.9	-118	8.2	1173	1265	6370	0.006	.17	.50	.33
Diphosgene ...	1.65	6.9	197.9	-57	128	10.3	1265	112	0.38	.25	1.0	.50
Chlorophosgene ...	1.66	6.7	164.5	-69	112	18.3	17.0	165	0.23	1.0	4.0	12.0
Xylyl bromide ...	1.4	6.4	185	210-220	0.07	0.07	.22	0.7	58.0	1-2	4	48
Bromacetone ...	1.63	4.7	137	-54	136	9	5.7	.08	0.5	72	168	108
Ethyl iodacetate (S.K.) ...	1.8	7.4	214	-21	179	0.34	0.095	0.13	325	Explosion 0.08		
Bromobenzyl cyanide (B.C.) ...	1.52	6.8	196	+25.8	244 (d)	0.012	0.065	0.13	325	Candle 0.17		
Chloroacetophenone (C.A.P.) ...	1.32	5.3	154.5	+38	333	0.013	0.060	0.105		24	108	108
Diphenyl cyanarsine ...	1.45	—	264.5	+33	377 (c)	0.0014	0.0014	0.00068		2-6	.17	12
Diphenyl cyanarsine ...	1.45	—	265	+33	377 (c)	0.0002	0.0002	0.0015		.08		
Diphenylamine chlorarsine ...	1.65	—	277.5	+105	410 (c)	0.11	0.188	0.98	38	24	108	108
Mustard Gas ...	1.28	5.4	159	+14.4	217 (d)	0.4	0.91	4.5	0.5	24	108	108
Lewisite ...	1.89	7.2	207.3	-5	190 (d)	0.4	0.91	4.5	0.5	24	108	108
Methyl dichlorarsine ...	1.84	5.5	161	-42.5	133	2.3	2.43	25	1.8	1-2	2-6	2-4
Ethyl dichlorarsine ...	1.96	6.0	175	-37	133	2.3	2.43	25	1.8	1-2	2-6	2-4
Hydrogen cyanide ...	0.7	0.94	27	-15	26.5	610	583	901	0.04	.08	.17	.17
Arsine ...	...	...	78	...	...	11,400	24,380	...	...	(10)	(11)	(12)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

during which it remains effective at the point of release, varies considerably with atmospheric and ground conditions. High temperatures and wind velocities, for example, will favour rapid evaporation; rain will effect a certain amount of mechanical washing away and in some cases destruction by hydrolysis; the persistence will be considerably greater in sheltered terrain than in the open, and similarly will be less if the liquid falls on impervious rocky material on which it spreads without sinking in, than if it falls on a porous material such as sand, where the reverse process will occur.

Prentiss in "Chemicals in War" shows persistences as periods of effectiveness during summer and winter—in the open and in woods. These periods, reduced to hours, are shown in columns 10 to 13 in Table I. In view of the influence of weather and ground conditions, it will be appreciated that these figures are only very rough approximations.

Persistence is usually related to the persistence of water under identical conditions, and in this case it varies inversely as the volatility (y) in mgm./litre at 20°C. so that R.P. at 20°C (water = 1) $\times y$ is a constant (s). The relative persistence calculated from the volatility is shown in column 9.

It is thus possible to calculate the volatility and relative persistence approximately from the molecular weight and either the vapour

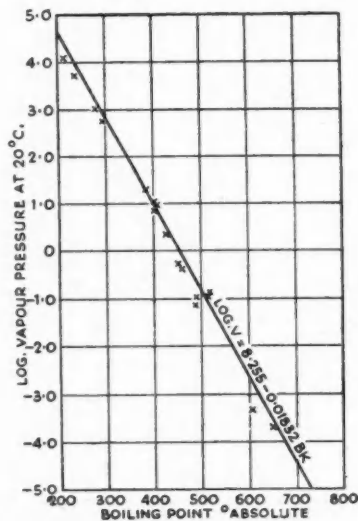


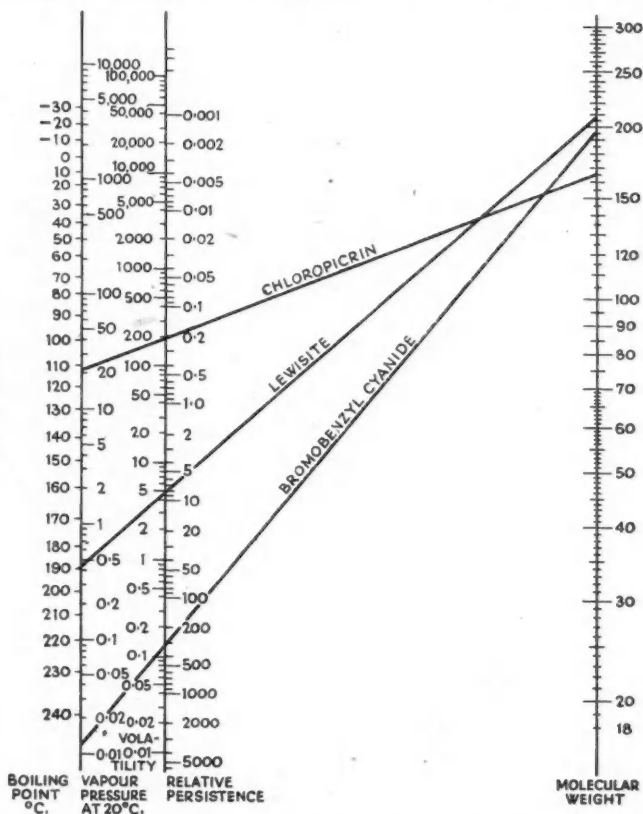
Fig. 2.

pressure or the boiling point of an organic compound, using formulae (2), (4) and (5). Further, to simplify the determinations the nomogram, Fig. 3, has been constructed. In

this the left-hand vertical is graduated in two scales representing boiling points $^{\circ}\text{C}.$ and vapour pressures at $20^{\circ}\text{C}.$ The middle

scale at a point representing the volatility and relative persistence of the gas. The examples show how the relative persistence

Fig. 3. Nomo-gram for the determination of volatility and relative persistence of poison gases.



vertical is also graduated in two scales representing volatility in milligrams per litre and persistence relative to water, while the right-hand vertical is graduated in molecular weights. A straight line drawn from the boiling point or vapour pressure of the gas on the left-hand scale to the molecular weight on the right-hand scale intersects the middle

or volatility of three typical gases may be determined.

Table 2 shows the features of certain lesser known gases which were used during the last war. Column 3 shows, in the case of cyanogen chloride, the determined vapour pressure of 1000, which agrees with value calculated from Formula 3.

TABLE 2.—Physical Properties of Lesser Known War Gases

	B. Pt. $^{\circ}\text{C}.$	Mol. Wt.	Vapour Pressure		Volatility		Relative Persistence	
			Determined	Calculated	Determined	Calculated	5	6
Ethyl bromoacetate ...	168	197	—	1.1	21	14	1.9	2.8
Benzyl bromide ...	201	171	—	1.0	2.4	2.2	18	18
Phenyl carbylamine chloride ...	210	174	—	0.17	2.1	1.5	19	27
Methyl sulphuric chloride ...	133	131	—	8.0	60	60	0.67	0.67
Dimethyl sulphate ...	188	126	—	0.5	3.3	3.0	12	13.3
Dichlorodimethyl ether ...	105	115	—	30	180	200	0.22	0.2
Dibromodimethyl ether ...	155	204	—	2.6	22	30	1.8	1.3
Cyanogen chloride ...	15	61	1000	1000	3300	3300	0.0012	0.0012
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Personal Notes

DR. R. F. BOWLES has joined B. Winstone and Sons, Ltd., as chief chemist.

MR. JOHN WILLIAMS, delegate director of I.C.I. (General Chemicals), Ltd., has completed 50 years' service with the United Alkali Company and I.C.I. A member of Widnes council since 1927, he was mayor of the town three years ago.

At next week's T.U.C. conference the Association of Scientific Workers will be represented by its national organiser, MR. BEN SMITH, and MR. R. S. BICKLE. Mr. Bickle is an explosives chemist in Government employment, and a member of the Association's executive committee.

MR. A. B. WINTERBOTTOM, M.Sc.Tech., who was recently repatriated to this country after a period of detention in Germany, is now working in the laboratories of the British Non-Ferrous Metals Research Association as a senior investigator. Before Norway was invaded, he was carrying out independent research at the University of Norway, Trondheim.

Obituary

Two officials of De La Rue Plastics, Ltd., were killed recently in an aeroplane crash in Southern Ireland. They were MR. I. K. THOM, works manager of the Walthamstow works, and MR. H. TRISTRAM, of the works in Scotland.

The death is announced of SIR HARRY ROSS SKINNER, M.Inst.C.E., M.I.M.M., at the age of 76. Before the last war he was technical director of the East Rand Proprietary Mines. Then he became director of High Explosives Supply in Lord Moulton's department, and for the period 1916-17 he acted as director-general of Munitions Inspection.

The death occurred suddenly on August 23, of MR. ROBERT MACFARLANE CLARK, B.Sc., F.I.C., F.C.S., of Wallace & Clark, the Glasgow firm of analysts and consulting chemists, at the age of 65. The last surviving son of the late Dr. John Clark, a former city analyst of Glasgow, Mr. Clark was, at the time of his death, public analyst for the counties of Lanark, Renfrew, and Ayr and of the burghs of Paisley, Kilmarnock, Ayr, Motherwell and Dumbarton.

New Control Orders

Polishes

The Limitation of Supplies (Polishes) (No. 3) Order (S.R. & O., 1943, No. 1206) continues the existing control for a further period of four months ending December 31, 1943, but it now covers the supply of *all* polishes (including creams and dressings)

made wholly or partly of wax, for whatever purpose they are intended, and such finishings, fillers, stains and inks containing wax as are used in the manufacture or repair of leather goods. Any manufacturers of goods which are thus controlled for the first time, whose names are not already entered on the Register of Manufacturers of Polishes, should apply to the Assistant Secretary, Industries and Manufactures Department 4, Board of Trade, Millbank, S.W.1, for registration.

Registered manufacturers may supply polishes for floor, furniture, leather and footwear to a value not exceeding 33½ per cent. of the supplies of these polishes made by them during the standard period (i.e., six months ending November 30, 1939), or £166 13s. 4d., whichever is the greater. Subject to certain conditions, registered manufacturers may still supply these polishes, in excess of their quotas, for export for the Services and for certain other privileged users. The value of these permitted types of polishes of their own manufacture which may be supplied by unregistered manufacturers who were supplying them on June 1, 1942, is reduced from £100 a month to £41 13s. 4d.

All manufacturers are prohibited from supplying any polishes made by them other than footwear, floor, furniture or leather polish, except under a licence granted by the Board of Trade. Materials for making polishes may be supplied only to persons who are authorised by the provisions of the Order to supply polishes of their own manufacture. The Order also embodies certain restrictions on the packing and marking of polishes.

The Board of Trade attaches particular importance to the maintenance of adequate supplies of boot and shoe polish, which is essential for the preservation of leather, and they hope that manufacturers will concentrate on its production as far as possible.

Toilet Preparations

The Toilet Preparations (No. 3) Order (S.R. & O. 1943, No. 1213), which came into operation on September 1, replaces the quota control by a system of individual licensing of registered manufacturers. Further restrictions amounting, after stated periods, to an absolute prohibition, are imposed on the supply of hair preparations containing petroleum products, and of toilet preparations containing more than 1 part in 200 by weight of acetone.

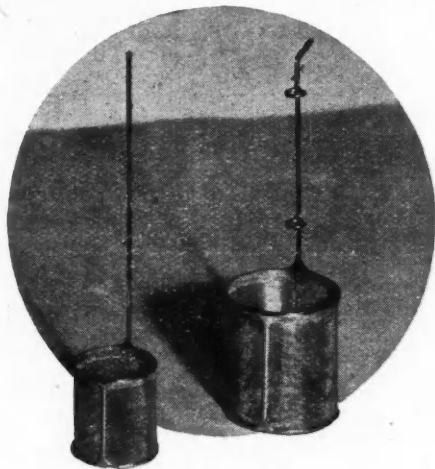
Technical Tallow and Greases

The Minister of Food announces that an amendment has been made to the Technical Tallows and Greases (Home Melt) (Maximum Prices) Order, 1941, as amended. On and after August 29, 1943, the maximum prices of all tallows and greases scheduled in the Order will be advanced by £12 10s. 0d. per ton.

Metallurgical Section

Published the first Saturday in the month

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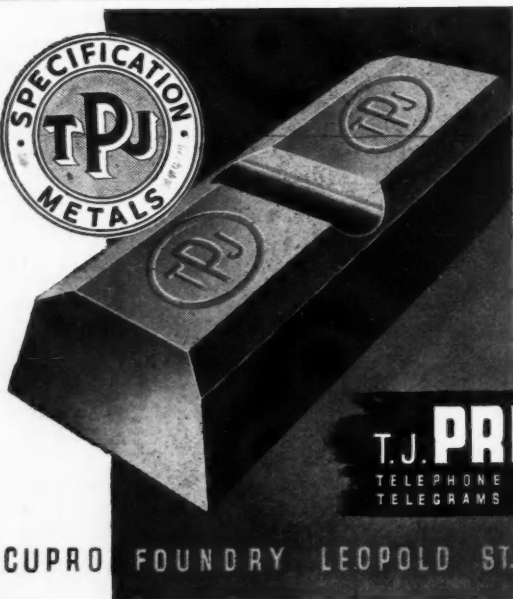
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Metallurgical Section

September 4, 1934

Applied Electrostatic Separation* Efficient Ore-Dressing Technique

ELECTROSTATIC separation is becoming more and more important in the production of critical minerals, and also in the reclamation of other valuable materials, as well as in the cleaning of some food products. At this time, when every effort is being made by metallurgical chemists and ore-dressing engineers to make use of all concentrating equipment available for the recovery of critical minerals and reclaimed materials, the subject of applied electrostatic separation is of vital interest.

The principle of electrostatic separation is simple. Under the influence of an electrostatic charge there is a difference in the susceptibility and behaviour of most materials, minerals, salts and food products. This can be controlled to a great extent by potential, polarity, temperature and conditioning of the surface of the particles. Often, by a combination of these factors, the desired separation is closely controlled. Many materials, under ideal conditions, can be separated with one electrode in the laboratory as is shown diagrammatically in Fig. 1. Practical experience, however, in the field of applied electrostatic separation, has well proven the necessity of multiple electrodes in series similar to flotation machine cells to compensate for the variations present in practical tonnage operation. (Fig. 2).

Electrostatic separation, like the application of flotation and other concentrating processes, involves highly specialised engineering experience to work out the best combination of controlling factors as well as the proper separator design for each application. When the best combination has been provided and applied, the separating efficiency is very high, and there is little variation in the recovery or grade of separated products. This has been the experience in many commercial installations.

During the past thirty-five years, applied electrostatic separation has experienced a steady growth in application involving the following separations: Silver concentrates, copper concentrates, zinc-iron middlings, iron ore, graphite ore, vermiculite ore, feldspar ore, fluor spar ore, rock salt, phosphate rock,

phosphate concentrates, sphalerite-galena, chromite beach sands, grindings from old grinding wheels and emery paper, silicon carbide from aluminous abrasives, zircon-rutile, recovery of coke from boiler ash, cleaning of coal, and the separation of chemical salts.

Electrostatic Separation Research

Formerly, it was generally accepted that minerals and other materials were separated electrostatically through the difference in degree of electrical conductivity of the particles. We have now learned that this indeed was a very broad classification. Many minerals, metallic and non-metallic, and other materials, accumulate a surface frictional charge through rubbing together in transit

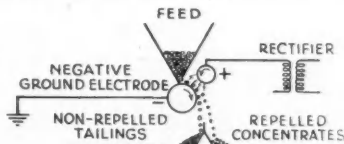


Fig. 1.—Shows the principle of electrostatic separation. The arrangement of smooth charged surfaces leads to the better conductive particles being repelled and deflected from their course.

conveying or through coming into contact with various metals and other surfaces while in motion. This is well demonstrated when dry screening many powders. The material which accumulates a frictional static charge agglomerates and quickly plugs the screen cloth.

The list of minerals (Table 1) indicates the behaviour of most common minerals under the influence of a static charge and represents the type of research work that is greatly contributing to a better understanding of applied electrostatic separation.

Thirty-eight of the ninety minerals examined show a definite preference and behaviour under the influence of a positive or negative charge. For instance, bituminous coal is easily repelled from anthracite coal

* Condensed from an article by H. B. Johnson in *Deco Trefoll*, April 1943.

under the influence of a positive charge, while it is depressed under the influence of a negative charge. Many materials are either repelled more easily or depressed by application of the best polarity.

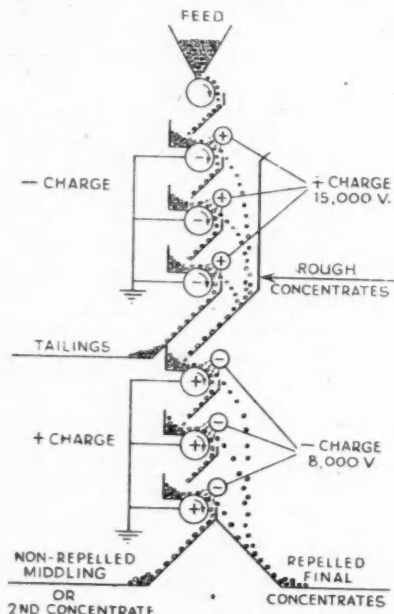


Fig. 2.—A typical series of separating electrodes for repeated treatment of ore; the use of two polarities at different potentials is shown.

Precharging the particle surfaces just before separation, also the selection of metals used in separator construction, often gives a most definite and reliable control of applied electrostatic separation. Very encouraging and important discoveries are now being developed commercially involving combinations of metals, temperature, potential, polarity, speed, and reagent surface conditioning, which greatly broaden the field of electrostatic applications for the future. Like the various combinations developed for successful flotation, such as dilution, water (acidity-alkalinity), agitation, reagents, and machine design, there is a best combination for each electrostatic problem which should be carefully worked out to assure the most successful operation.

Plant research and experimental work formerly associated with electrostatic separation has been almost entirely eliminated through greatly-improved application. Commercial installations now duplicate laboratory

work almost immediately. Installations are now made with a much better knowledge of requirements through actual measurements and careful consideration involving the proper combination of the controlling factors.

The data contained in Table 1 can be applied to the separation of mixtures of particular minerals in the light of the following general rules. The non-reversible minerals are repelled by either a positive or a negative polarity. These minerals, therefore, are separated by the difference in voltage or potential applied between the separating electrodes, one being repelled further than the other, thereby easily separated at a given voltage or potential. For example: Graphite No. 1, with a voltage listing of 2800 is easily separated from corundum No. 31, with a listing of 13,728. Both of these minerals are listed as non-reversible, both are susceptible to either polarity. The reversible minerals are listed as RP (reversible positive, or more susceptible to a positive polarity), and RN (reversible negative, or more susceptible to a negative charge). This means that when using a positive charge the RP minerals are repelled while the RN minerals are depressed. Therefore a wider split is made by applying the proper polarity, and a separation of minerals listed at approximately the same voltage is possible. This would not be the case if two non-reversible minerals at approximately the same voltage were used. For example: Cryolite No. 23 and marcasite No. 20 are listed at the same voltage, 5460. Marcasite is non-reversible, but cryolite is reversible positive. If a negative charge is applied, no separation is possible, because the cryolite is depressed and remains with the marcasite. But if a positive charge is applied, then the cryolite is easily repelled from the marcasite, and a separation of these two minerals is accomplished.

Selection of Polarity

By the use of proper polarity, some selection is possible. For example: In the separation of phosphate from sand, or in the separation of cement rock, the smallest portion (sand) is more cleanly repelled if a positive polarity is applied, while the highest degree of separation is not possible if a negative polarity is used. Best selection of polarity, indicated by the mineral list, involving the associated minerals in any ore or head feed, leads to most positive and profitable operations at lowest cost.

This mineral list deals only with the electrostatic behaviour of minerals crushed to a workable size, surface dried, and in the natural state. It does not take into consideration any known changes in behaviour through pyroelectric, temperature, or surface conditioning through the use of various reagents—surface coatings. Neither does it deal with the natural frictional charges

TABLE I.—ELECTROSTATIC BEHAVIOUR OF VARIOUS MINERALS

No.	Mineral and Chemical Composition	Voltage	Reversible*	No.	Mineral and Chemical Composition	Voltage	Reversible*
NATIVE ELEMENTS				SILICATES			
1	Flake graphite ...	2,800	Non	49	Microcline ...	7,488	Non
2	Graphite-plumbago ...	3,588	Non	50	Oligoclase ...	6,240	RN
3	Sulphur ...	10,920	RP	51	Labradorite ...	4,992	Non
4	Arsenic ...	6,552	Non	52	Enstatite ...	7,800	RN
5	Antimony ...	7,800	Non	53	Pyroxene ...	6,084	RN
6	Bismuth ...	4,680	Non	54	Amphibole-hornblende ...	7,020	RN
7	Silver ore ...	6,552	Non	55	Nephelite ...	6,240	Non
8	Iron in basalt ...	7,800	Non	56	Garnet ...	18,000	Non
SULPHIDES OF THE SEMI-METALS				57	Rhodolite ...	16,380	RP
9	Stibnite ...	6,864	Non	58	Almandite ...	12,480	Non
10	Molybdenite ...	7,020	Non	59	Chrysolite ...	9,204	RP
11	Galena ...	6,864	Non	60	Zircon ...	11,700	RN
12	Chalcocite ...	6,552	Non	61	Topaz ...	12,480	RP
13	Sphalerite ...	8,580	RN	62	Kyanite ...	9,204	Non
14	Niccolite ...	7,800	Non	63	Axinite ...	10,296	RN
15	Pyrrhotite ...	6,552	Non	64	Calamine ...	9,048	Non
16	Bornite ...	4,680	Non	65	Fourmaline ...	7,176	RN
17	Chalcopyrites ...	4,680	Non	66	Muscovite ...	2,964	RN
18	Pyrites ...	7,800	Non	67	Lepidolite ...	4,992	Non
19	Smaltite ...	6,396	Non	68	Biotite ...	4,836	Non
20	Marcasite ...	5,460	Non	69	Serpentine ...	6,084	RP
HALOIDS				70	Talc ...	6,552	Non
21	Halite ...	4,056	Non	71	Kaolinite ...	6,708	RN
22	Fluorite ...	5,148	Non	72	Bentonite ...	3,588	Non
23	Cryolite ...	5,460	RP	PHOSPHATES			
OXIDES OF SILICON				73	Monazite Sand ...	6,552	Non
24	Quartz, chert ...	8,892	RN	74	Apatite ...	11,700	RP
25	Quartz, smoky ...	9,672	RN	SULPHATES			
26	Quartz, flint ...	10,140	RN	75	Barytes ...	5,772	Non
27	Quartz, gold ...	10,140	RN	76	Anhydrite ...	7,800	RP
28	Quartz, crystal ...	13,416	RN	77	Gypsum ...	7,644	RP
29	Quartz, milky ...	14,820	RN	TUNGSTATES-MOLYBDATES			
30	Quartz, rose ...	14,820	RN	78	Wolframite ...	7,332	Non
OXIDES OF METALS				79	Scheelite ...	8,580	Non
31	Corundum ...	13,728	Non	80	Wulfenite ...	11,700	Non
32	Haematite ...	6,240	Non	HYDROCARBON COMPOUNDS			
33	Ilmenite ...	7,020	Non	81	Anthracite ...	3,588	Non
INTERMEDIATE OXIDES				82	Bituminous coal ...	4,056	RP
34	Magnetite sand ...	7,800	Non	83	Bituminous coal, coking ...	6,240	RP
35	Franklinite ...	8,112	Non	ARTIFICIAL ABRASIVES			
36	Chromite ...	5,616	Non	84	Aluminous oxide ...	13,572	RP
37	Rutile ...	7,332	Non	85	Silicon carbide ...	5,616	Non
38	Pyrolusite ...	4,680	Non	BEACH SANDS			
39	Manganite ...	5,616	Non	86	Rutile (Australian) ...	7,488	Non
40	Limonite ...	8,580	Non	87	Zircon ...	11,076	RP
41	Bauxite ...	8,580	RN	88	Rutile (Indian) ...	8,892	Non
CARBONATES				89	Zircon ...	11,076	RP
42	Calcite ...	10,920	RP	* Non, not reversible. RP, reversible positive. RN, reversible negative.			
43	Dolomite ...	8,268	RP				
44	Magnesite ...	8,580	RP				
45	Siderite ...	7,176	Non				
46	Rhodochrosite ...	8,580	Non				
47	Smithsonite ...	12,480	RN				
48	Aragonite ...	14,800	RP				

accumulated by some minerals through coming into contact with different metals, materials, or composition surfaces.

Electrical Equipment

For supplying the electrostatic charge, two types of electrical equipment are generally used—the mechanical rectifying electrical set and the tube rectifying electrical set. Both types of electrical sets are far beyond the experimental stage and are very reliable in continuously furnishing an electrostatic charge of the desired characteristics selected for any separation.

The mechanical rectifying electrical set is generally used for the higher potential requirements and larger installations. It consists of a motor, exciter, generator, and mechanical rectifiers mounted on a common drive shaft. The generator furnishes 110-volt, single-phase current, which is stepped up through transformers, then is rectified to several wave characteristics for various requirements. The electrical apparatus is mounted on a welded-steel base on castors. It is easily removable and is completely enclosed and protected from dust. The static

charge capacity is greatly in excess of commercial operating requirements. It can be connected to any lighting circuit or power line. The drive motor is supplied to meet

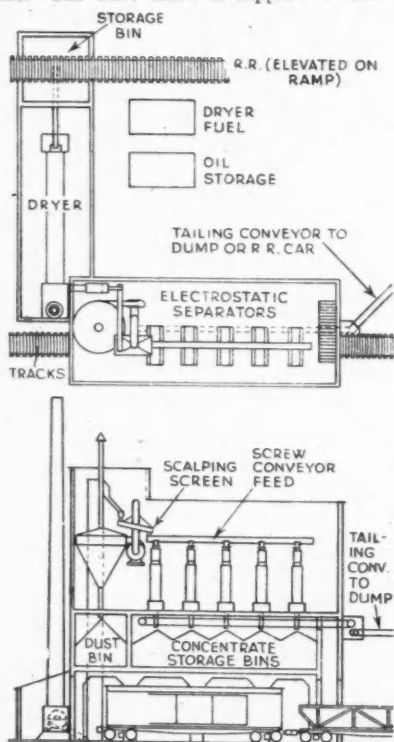


Fig. 3.—Lay-out for a commercial electrostatic separating plant.

any electric current specifications available. The actual power requirements are from 1.5 to 2 h.p. Repair and maintenance are practically negligible.

Arrangements are provided for the supply of both a negative and a positive charge simultaneously, so that both charges may be supplied to several separating groups of electrodes used in each separator, or one group of separators can be supplied with a negative charge while another group is supplied with a positive charge. Likewise, different potential and wave characteristics may be used as required for two different separations made in one pass through the separation equipment.

Separating Equipment

Practical applications involve a series of separating electrodes which are used in

several combinations so that the separated products may be continuously re-treated and a complete separation made in one pass through the separating equipment. This is very important when two polarities are used, or in some cases where reagents or temperature control is involved. From laboratory tests and investigations, the electrode arrangements or flow-sheet treatment is carefully worked out for each separation. Then commercial size separators are assembled accordingly, and there is little difficulty experienced in duplicating laboratory results in plant operation. A modern electrostatic separator, like a flotation machine cell arrangement, involves a flowsheet treatment within itself. Fig. 3 shows a satisfactory layout for a separating plant.

Power Requirements

The power required for revolving the steel, brass or copper separating-electrodes is so small that multiple continuous electrode treatment adds practically no expense. It has many important advantages, such as better separation control, slower electrode speed (35 to 60 r.p.m.), less critical adjustments, and greatly reduced handling cost as well as labour supervision, maintenance and repair cost. Separators are manufactured in sections containing three electrodes, each section weighing approximately 1500 pounds. These sections can be handled easily during installation and assembled like a portable book case according to specifications for each installation. The separators are designed for heavy duty continuous operations and when assembled will weigh from 8000 to 15,000 pounds. All bearings are totally enclosed. Likewise, the revolving electrode power transmission is completely lubricated and enclosed, thereby protected from any dust or moisture. A double 8-foot separator has 16 feet of feed roll with a separating capacity varying from 800 to as high as 1000 pounds per linear foot (6 to 12 tons) hourly, 144 to 288 tons daily. The number of separating electrodes used vary from three to twelve, depending upon the separation required. The building space requirements are 4 foot width, 10 foot length, and 10 foot height.

Actual power requirement for each separator is from 2.0 to 3.5 h.p., depending upon the type and size separator used or approximately 0.30 h.p. per ton of head feed capacity. The largest electrostatic separating plant, producing from 600 to 675 long tons of concentrate per 24 hours, has for the past three and a half years averaged 2.75 kWh per ton of head feed separated, which includes the required scalping screen, elevators, conveyors, weighing scales, samplers, motors and dust collecting system for handling the material from the drier discharge to the concentrate storage bins, as well as the tailings disposal. The potential across the separating electrodes varies from 5000 to 18,000 volts depending upon the

material to be separated. The charged separating electrodes are insulated for 100,000 volts. Therefore, there are practically no power losses. The static charge is harmless from a safety standpoint. The amperage at the separating electrodes when operating at full separating capacity has been measured by competent engineers at 50 microamperes. There is no record of anyone being injured in any way by receiving a shock from well-known commercial electrostatic separating equipment. It is not in any way affected by changes in climatic conditions. Several commercial plants are operating continuously between sea level and 8000 feet altitude, exposed to all variations and conditions experienced in the mining industry. Separating equipment adjustments are quite simple and can be made by any operator. The feed gate adjustments are made for the maximum capacity and then locked.

Efficiency of Separation

Variation in head feed capacity has little effect upon the separating efficiency for the reason that each of the 16 linear feet of separating electrodes is making the same degree of separation whether the feed is covering one linear foot or the total 16 feet. The number of electrodes used and their combination or flowsheet arrangement controls the separating efficiency. Therefore, the separated products are approximately the same grade, whether one, ten, or the full 16 feet of separating electrodes are used. Usually, the recovery and grade of products in a well-designed electrostatic separating plant will not vary more than 1 to 2½ per cent. from month to month. Provision is made for prompt removal of all colloidal-sized floating dust so that the plant is clean and working conditions are very satisfactory. This has been a great improvement over the older electrostatic installations, where sometimes little attention was given to working conditions. Improvement in equipment design and application, using a series of separating electrodes, has for many materials practically overcome the necessity of close sizing. Several important separations are made on minus 20-mesh head feed, and screen tests of the separated products show little difference in separating efficiency between the coarse and finer sizes.

Below are two typical electrostatic separations:—

Vermiculite Ore (minus 6-mesh).

Products.	Per cent.
Electrostatic head feed	32.0
Electrostatic concentrates	96.5
Electrostatic tailings	3.5
Recovery of vermiculite—	92.4 per cent.

Chromite Beach Sands
Jig Concentrates.
(minus 20-mesh).

Products.	Chromic oxide (Cr ₂ O ₃) per cent.
Electrostatic head feed	23.37
Electrostatic concentrates	41.59
Electrostatic tailings	1.24
Recovery of Cr ₂ O ₃ —	97.60 per cent.

Applications

The process has wide application in the mining industry, used as a method of further separating or refining middlings or concentrates where there are possibilities of earning premiums for higher grade, reducing penalties or saving in transportation charges. In the refining of phosphate flotation concentrates the increased premium value per ton is approximately 60 cents against a separation and handling cost of 30 cents per ton.

The labour cost, particularly when handling tonnages over 250 tons daily, is exceptionally low, likewise the power cost so that it is economical to handle large tonnages of many low-value materials, such as iron ores, phosphate rock, cement rock, coal, etc. Where the recoverable minerals are over 40 per cent. in volume, the drying cost of the gangue or tailings is largely offset by the savings in reagent and water handling charges. For the concentration of low-grade ores, where the recoverable minerals are less than 40 per cent. of the volume, wet methods are usually more economical.

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WELDING ALUMINIUM ALLOYS

Although aluminium has been welded successfully for some 40 years, there are still many in industry who are not familiar with the technique required for fusion welding of aluminium, while even less is known about the welding of the alloys. A 52-page booklet entitled "Fusion Welding of Wrought Aluminium Alloys" deals with the underlying reasons for the various difficulties encountered by operators inexperienced in the welding of aluminium and describes how the characteristics of the metal affect the welding procedure required for each of the fusion processes. A table is included summarising processes recommended for each type of aluminium alloy. This publication, which is illustrated by photographs and diagrams, can be obtained from the Wrought Light Alloys Development Association, 63 Temple Row, Birmingham 2.

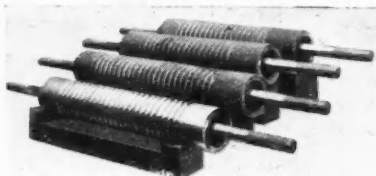
Acid-Resisting Metal

A Notable High-Silicon Iron

FOR the chemical industries requiring materials with very high resistance to corrosion by acids of interest is a special metal made by Meldrums, Ltd., Timperley, near Manchester, which is hardly affected, for example, by sulphuric, nitric, acetic, chromic, oxalic, and many other acids, whether cold or at boiling point, and irrespective of concentration. Also a special variety is available which is resistant to hydrochloric acid. Although the full details are not available, it can be stated this "Meldrum" metal is a high silicon iron, made by a special process. The firm's extensive experience in this field, dating from the last war, and they have gradually perfected the metal until, to-day, satisfactory castings can be made up to 2 tons in weight. The properties of silicon iron in general are, of course, familiar knowledge, but one of the difficulties has been to produce castings of considerable weight and size. In general this special metal has an excellent heat conductivity, is extremely hard and durable, and much superior, therefore, to pottery and earthenware as regards standing changes of temperature and stresses. Further, it has the obvious advantage, as compared with any method of painting, coating, or enamelling, of having uniform acid-resisting qualities right through, and it is therefore not affected, for example, by abrasive action.

A very large amount of chemical plant and equipment made of this metal is available, including acid eggs, stills, mixing pans, storage vessels, automatic acid elevators, agitators, ejectors, vacuum apparatus, steam jet blowers, jacketed pans, and acid pumps. Further, the machined surfaces take a good finish by grinding, so that the metal is par-

ticularly suitable for such purposes as spindles on the ends of rollers used in connection with equipment such as dyebecks that contain acid solutions, as in wool and artificial silk dyeing. The firm also specialises on steam jet equipment for elevating, conveying, agitating, oxidising, and other uses, and the metal is particularly valuable in this connection since it can be used with any acid or acid solution, whether containing crystals or otherwise.



Serrated rollers of "Meldrum" metal used in the galvanising of iron wire. They take the wire as it comes from the acid flux, prior to treatment in the galvanising bath.

To give some indication of its resistance to corrosion, below are tabulated the results of detailed tests carried out by boiling for periods of 24 hours, 48 hours and 72 hours in various acids. It will be seen that the effect is negligible. Similar detailed figures are available concerning tests with such diverse products as a 10 per cent. solution of iodine (cold), a saturated solution of bleaching powder (cold), and a 20 per cent. solution of ammonium chloride (boiling).

Treatment	Initial Weight Grams.	Weight after Treatment for :—		
		24 hours	48 hours	72 hours
Sulphuric acid (strong) ...	112.648	112.714	112.737	112.806
Sulphuric acid (1.2) ...	115.207	115.233	115.226	115.244
Nitric acid (1.2) ...	116.629	116.616	116.613	116.614
Acetic acid ...	115.475	115.485	115.502	115.507
Chromic acid (10%) ...	115.264	114.717	114.633	114.594
Oxalic acid (25%) ...	117.867	117.826	117.806	117.776
Tartaric acid (25%) ...	117.428	117.400	117.327	117.274

The new chairman of the Agricultural Research Council is Lord De La Warr, in succession to the late Sir Thomas Middleton. Professor I. de Burgh Daly, F.R.S., physiology professor of Edinburgh University, has been appointed a member of the council in place of Sir Joseph Barcroft, F.R.S., whose term of office has expired.

A committee to develop the coal-dust motor, with a view to obtaining early practical results, has been formed in Germany under the chairmanship of Professor Wagener. All firms working in the field are affiliated to the committee, one of whose objects it is to avoid duplication of research work. Trial runs are to take place soon.

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South American Rotenone

Lonchocarpus Cultivation on the Amazon

DERRIS and lonchocarpus are the richest sources of rotenone-containing insecticidal material. According to an article in *Foreign Commerce Weekly* by E. C. Higbee, U.S. Department of Agriculture, increasingly large areas of land in the Caribbean republics and in Central and South America are being planted with these plants, the species cultivated being *Derris elliptica*, *Lonchocarpus utilis* and *L. urucu*. Derris, in a number of different varieties, originates from the Far East; Lonchocarpus, a closely-related plant, is a native of the New World. Before America entered the war she depended for 49 per cent. of her rotenone imports on the Far East; the remainder was supplied by Peru, Brazil, and Venezuela. The Amazonian regions of the first two countries are now her main source of this insecticidal material. Commercial derris is harvested when 1½-2½ years old; plantation-grown lonchocarpus is harvested when between 2 and 3 years old.

"Vegetable Gold"

A drawback to the rapid expansion of both crops is the fact that they are not grown from seed, but instead have to be propagated vegetatively by means of stem cuttings taken from harvested plants. Recent derris plantings in the Western Hemisphere have been made by cuttings sent by air from the U.S. Department of Agriculture's experimental station in Puerto Rico and from the Panama plantations of the Goodyear Rubber Company. Before the war Venezuela was sending over 100,000 lb. of lonchocarpus roots to the United States each year, and the annual imports from Brazil amounted to nearly 1,800,000 lb., but production in both countries has tended to decline, due mainly to the fact that few large-scale plantings have ever been made, the rotenone-bearing materials being obtained in the main from small, scattered, half-wild plants grown by Indian and river-bank dwellers for fish-poison purposes. Recently, efforts have been made in the State of Pará, Brazil, to encourage a plantation industry, a previous export ban on unmilled crude roots being lifted; the national Instituto Agronômico do Norte at Belém has established a 250-acre lonchocarpus nursery from which cutting material of this plant, known locally as "timbo" (other synonyms for lonchocarpus are eubé, haiari, nekoe, and barbasco) will be distributed to the increasing number of interested planters. Principal Brazilian centres producing semi-wild timbo are in the region about the village of Portel, along the Xingu and Tapajoz rivers, and in the upper

Amazon regions in the State of Amazonas. In Peru, lonchocarpus production has made considerable progress during the last ten years; exports to all countries mounting from 12,244 kg. in 1933 to 1,544,020 kg. in 1942. Next year's total should run to well over 2,000,000 kg. This progress is due to the wide interest taken in plantation-grown lonchocarpus which developed during the late 1930's; at the beginning of June this year 7000-7500 acres were planted with *Lonchocarpus utilis*, or "huasca barbasco" as it is known in Peru. During this year alone 4000 acres will have been planted. The present cost of producing the root—including felling of forest trees to make room for plantations, cultivating, and harvesting—averages 60-75 American dollars per acre. Average yields are 1500-2500 lb. of dry root per acre. That the crop is considered profitable by the people of Peru may be judged from the fact that they have given it the nickname of "oro vegetal"—vegetable gold! To-day, it is true to say that barbasco exports have a total monetary value higher than that of any other single product from the Peruvian Amazon.

Tests made by the Brazilian Instituto Agronômico do Norte show that there is a wide variation in rotenone-content between individual plants of the *L. utilis* species. Of 67 separate plants analysed by the institute, 40 contained less than 5 per cent., one had between 5 and 10 per cent., while 26 had 10-20 per cent. The 67 samples averaged 6.91 per cent. rotenone. The institute is now engaged in multiplying the high-yielding strains, and supplies of these improved stocks will eventually be distributed to commercial growers. Parallel studies are being made with the species *L. urucu*. A similar research project is the concern of the Peruvian Instituto Técnico Químico Industrial del Oriente at Iquitos which is co-operating with the U.S. Office of Foreign Agricultural Relations.

Improving Drying Methods

The drying of the roots is a problem needing close investigation. In the Amazon, for instance, the freshly-dug roots do not dry readily, with the result that they frequently undergo serious decomposition, being attacked both by fungi and, curiously enough, by insects that are immune to rotenone. The average drying period in Iquitos is three months, and the process may take even longer. The current technique is to stack the roots 3-5 feet deep on cement floors or wooden platforms, turning them over at intervals of 10-20 days. Experiments in

which the roots were torn into strips to increase the surface area have shown that it is possible to complete air-drying within a fortnight, but it is not yet known whether this would be profitable on a commercial scale. At two factories silage cutters have been used to chop roots prior to oven-drying and subsequent milling, and one exporter has been trying the effect of using silage cutters coupled with air-drying, the chopped roots being raked daily in a manner similar to that employed in drying coffee. That improvements will be made seems certain in view of the fact that, with the increasing importance of the rotenone trade in the Amazon, local merchants are now taking a much keener interest in the quality of their product and are seeking to better it so that they will be able to retain, after the war, the excellent markets of to-day. Improved drying, coupled with the growing of strains of plants selected for high-rotenone content, should enable them to place on the market a sound dry root higher in insecticidal properties than anything at present offered.

Manganese from Low-Grade Ores

Electrolytic Process of U.S. Mines Bureau

MORE than 100,000 lb. of metallic manganese, recovered from low-grade domestic ores by an electrolytic method developed in Bureau of Mines laboratories, have been delivered to the Treasury Department for lend-lease and to the United States mint. Discovered and developed by Bureau engineers between 1935 and 1938, the electrolytic process extracts high-purity manganese metal from low-grade ores through leaching and electrolysis.

Using its own patented process, the Bureau of Mines for nearly two years has been producing electrolytic manganese in a pilot plant at Boulder City, Nev., while expediting other exploration and research phases in a plan designed to yield sufficient domestic manganese for manufacturing 87,000,000 tons of steel annually. Approximately 12 lb. of manganese go into each ton of steel and give it strength and workability. Before entering the war the United States was importing more than 90 per cent. of its manganese requirements, chiefly from Russia and India. Since then, however, domestic production has increased slightly, and some shipments have been received from abroad.

At the outbreak of war in Europe in 1939 the Bureau's normal programme of manganese research was speeded up. By authorisation of Congress, engineers of the Bureau of Mines and the Geological Survey broadened and intensified their search for domestic mineral deposits containing manganese and other strategic minerals. In the autumn of 1940,

an appropriation of \$2,000,000 was made available to the Bureau for the construction and operation of pilot plants to beneficiate low-grade manganese ores, to produce metallic manganese from these ores, and to develop manganiferous deposits.

Meeting the urgency of the situation, the Bureau since 1939 has engaged in 37 projects for manganese exploration, has completed 34 and still is working on three. In some projects, a number of ore deposits were examined. As a result of this exploration, the estimated reserves of usable manganese ore in the United States have been increased by several million tons. The Bureau believes that application of the available processing methods to the known ores can make the United States self-sufficient in manganese.

There are two general processes—milling and hydrometallurgy—which can be used efficiently on low-grade ores, the Bureau has determined. The low-grade ores in the United States contain from 1 to 30 per cent. manganese, and milling methods, which are relatively inexpensive, produce a concentrate up to 48 per cent. manganese. Hydrometallurgical methods, which dissolve the manganese away from inert materials for eventual recovery by chemical or thermal methods, produce a concentrate of 60 to 65 per cent. manganese. One of the newest processes developed in Bureau laboratories is the dithionate modification of a sulphur dioxide leaching method (hydrometallurgy), which is now being tested in a pilot plant in co-operation with the American Smelting and Refining Company at the latter's smelter at Garfield, Utah, utilising waste sulphur dioxide from the smelter.—*Chemical Industries*, 1943, 52, 6, p. 745.

ELECTRONIC WELDING

IN last week's issue of *THE CHEMICAL AGE* (p. 210) was printed an article on dielectric heating by means of radio-frequency currents. A similar technique can be applied to the welding of metal plates. According to *Journal of Applied Physics* (May, 1943) such plates can now be put together at speeds as fast as 1800 welding "stitches" a minute, with the aid of electronic tubes much like those in an ordinary radio set. Peak production in many plants depends upon resistance welding done by machines which have water-cooled copper jaws that clamp down to hold together the two pieces of metal being welded. When electricity passes through the jaws and into the metal, heat is created to weld the two inner surfaces tightly together. On some jobs the jaws are replaced by copper wheels that roll over the metal, making a continuous seam between the two pieces. Both in speed and efficiency this method is an improvement over previous methods used.

General News

In the article on "Recent Developments in Analytical Chemistry," in *THE CHEMICAL AGE* last week, reference to Note 36 (p. 206, col. 2, l. 33) was inadvertently omitted. The reference is to Carruthers, *Ind. Eng. Chem., Anal. Ed.*, 1943, 15, p. 70.

The Ministry of Fuel announces the award of 19 scholarships and 9 exhibitions under the Miners' Welfare National Scholarships scheme. Of these scholars, six will be studying chemistry at various universities, and another six will be taking an honours degree course in mining.

Although the Institution of Mining and Metallurgy and the Institution of Mining Engineers are returning to their former premises (Salisbury House, Finsbury Circus, E.C.2) about the end of this month, their joint library will remain for the time being at Mill Close Mine, Darley Dale, Derbyshire.

An explosion in the chemical laboratories of Professor H. V. A. Briscoe's department at the Royal College of Science caused the death last week of a 19 years old student, Mr. John Knowles. The inquest was opened at Hammersmith on Monday and adjourned until September 20.

The Minister of Health stated last week that no less than 4,500,000 tons of valuable materials had been recovered from salvage. He added that after the war it might be a long time before materials were in anything like the bountiful supply they were before the war, and it might well be that housewives would still be under a legal obligation to sort out materials as they were to-day.

A study of absenteeism among women workers at two Royal Ordnance factories in June and August last year showed that married women lost more time than single women and that absenteeism was highest on Saturday and low on pay days. A report of the investigation, carried out by three representatives of the Industrial Health Research Board for the Ministry of Supply, has been published by H.M. Stationery Office, price 2d.

The Trading with the Enemy (Specified Persons) (Amendment) (No. 11) Order, 1943 (S.R. & O. 1943, No. 1160) contains 228 additions to the list of traders in neutral countries with whom it is unlawful to have dealings of any kind. Among these is included *Chemische Fabrik Pilot A.G.*, Steinertstr. 23, Basle, Switzerland. Among the 90 deletions are: *Laboratorios Novoterápica, Ltda.*, S. Paulo, Brazil; *Colorificio S. Giorgio*, Casilla 71, El Peñón, La Calera, Chile; *Merck Mexico S.A.*, Mexico City; and *Fabrica de Productos Químicos y Farmacéuticos*, Carpio 105, Mexico City.

From Week to Week

The Educational Books Section of the Red Cross and St. John has dealt with 26,000 requests from British prisoners of war in Europe since its formation early in 1940. Over 163,000 study books and courses have been sent to these men. In addition, a reserve of 50,000 educational books has been set up at Geneva.

A Cambridge scientist, Dr. A. E. Alexander, of the Colloid Chemistry Department, has developed a new wax-sealing compound known as Lexil which can be used for domestic fruit bottling. The essential materials required are home-produced, and its use will enable rubber and steel, which form the basis of most vacuum methods of bottling, to be saved. The Ministry of Food has approved the composition which is now available to the general public.

How Lavoisier was responsible, indirectly, for the foundation of an important branch of the American chemical industry is revealed by Sir Harold Hartley in an article in *The Times*. Lavoisier's assistant at the Arsenal, Irénée du Pont, saved from the revolutionaries by a miracle, emigrated to America in 1792, where he set up his own powder factory at Wilmington, the germ of the great American chemical firm of E.I. du Pont de Nemours.

Dundee's advantageous position for developing post-war industries centred on plastics and other synthetic products was emphasised by Dr. Robert Roger, chemistry lecturer, at University College, Dundee, when addressing the "Development of Industries" sub-committee in the City Chambers last week. He said that development of laminated plastics was important to the city, and explained how linen and jute could be converted into a stiffer and more lasting article by impregnation with plastics.

Foreign News

The Swedish *Aktiebolaget Oxygenol* has formed a subsidiary for chemical and pharmaceutical products.

A new factory at Falkenberg in western Sweden is producing sodium silicate and other products.

Hungarian Oil Works Co., Budapest, has been formed for the treatment of vegetable oils and coal distillates.

Hungarian Magnesium and Electron Co. is a newly-formed, State-owned company which is to produce magnesium by the I.G. Farben-industrie process.

Hungaria Fertiliser, Sulphuric Acid and Chemical Industry Co. intends to build a soda factory which is to meet the entire Hungarian demand.

Pharm-Ost G.m.b.H. has been formed by German interests for the distribution of medicinal and pharmaceutical products in the German-occupied Eastern territories.

Faser-Industrie G.m.b.H. has been formed at Coburg, Germany, for the manufacture of plastics, threads, silks, yarns, etc. by the heat-treatment of glass.

Another "Lucite" plant has started production of the transparent methyl methacrylate resin used in the gun turrets of American bombers, reports the plastics department of du Pont de Nemours.

Fodder yeast is to be made in Sweden by Aktiebolaget Fiskeby. The company is also experimenting with a high-grade kind of yeast which is described as a substitute for beef extract.

The recovery of fat from slaughter-houses is to be undertaken on a systematic scale in Hungary, in the hope of obtaining sufficient fat for the manufacture of 120-140 tons of standard soap per annum.

The difficulty of obtaining sufficient supplies of tung oil has led the United States to import oiticica oil from the State of Ceará, Brazil. The same State also provides the U.S.A. with large quantities of carnauba and urucuri wax.

Union Aktieselskab, of Oslo, a Norwegian paper and pulp company, has opened a new alcohol plant at Skien with an annual capacity of 8000 hectolitres. Greaser Cellulose Co. also intends to produce sulphite alcohol.

A new rubber substitute, known as "Tolep," has been registered as a Palestine patent. The material has been produced by a Jewish refugee from Poland, now in Jerusalem, who has been helped in his research work by the Jewish Agency and the Hebrew University of Jerusalem.

Hungarian Viscosa Co. reports that the construction of their new plant is making good progress and that full production will be reached within a few months. The firm's "Macosa" yarn, a cotton-like fibre produced by special treatment of bast fibres, is the first one of entirely Hungarian origin.

A plant for the fixation of atmospheric nitrogen, costing £500,000, has been erected at a New South Wales factory. This is only one of several such plants in Australia, and, although to-day, the plant makes ingredients for explosives, the same plant will later produce chemicals for drugs, dyes, and fertilisers.

A surplus of aluminum exists in America, states the *National Waste Review*, which attributes this to labour shortage for melting it to a temporary lag in the consumption by the aircraft industry. The paper urges that some metal should now be released for the manufacture of domestic cooking utensils.

A new process of "welding" fabrics, to replace the conventional machine sewing, has been perfected by the American Celanese Corporation, reports the *Wall Street Journal*. A nichrome wire replaces the steel needle and a silver contact-spring takes the place of the shuttle. By contact with an electrical circuit the fabric, it is claimed, is welded at each point touched by the heated wire. The effect, presumably, is one of induction heating.

Forthcoming Events

The 1943 conference of the **Association of Special Libraries and Information Bureaux** to be held in the rooms of the Royal Society, Burlington House, London, W.1, on **September 18-19**, will discuss some of the outstanding problems of the rehabilitation of special library and information services after the war, with a view to giving a lead to immediate action. At the inaugural session, Professor J. D. Bernal, F.R.S., will draw a picture of what must be expected of information services if they are to fulfil their positive function in the scientific life of the post-war world.

The **Faraday Society** is holding a whole day conference on "Modes of Drug Action" at the Hotel Rembrandt, South Kensington, on **September 24**. Sir Henry Dale, president of the Royal Society, will open the conference, and the symposium will include papers by Professor J. H. Gaddum, Professor E. K. Rideal, and Professor C. N. Hinshelwood.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1906 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

RADIOVISOR PARENT, LTD., London, N.W. (M., 4/9/43.) August 5, debenture, to British Mutual Banking Co., Ltd., increasing the amount secured by debenture dated March 16, 1939, from £3000 (not ex.) to £14,000 (not ex.); general charge. *—, August 6, 1942.

UNIVERSE PETROLEUM CO., LTD., London, E.C. (M., 4/9/43.) August 12, assignment, securing to Midland Bank, Ltd., all moneys due or to become due from Universe Marketing Co., Ltd., to the Bank; charged on certain moneys. *£16,500. August 4, 1943.

Satisfaction

RADIOVISOR PARENT, LTD., London, N.W. (M.S., 4/9/43.) Satisfaction August 5, of mortgage registered September 8, 1942.

Company News

Solignum, Ltd., announce a profit to March 31 of £20,000 (£11,865). Carry forward is £1631 (£1247).

British Oil and Cake Mills, Ltd., are paying no dividend for 1942 on the ordinary shares (all of which are held by Unilever, Ltd.), as against 5 per cent. for 1941.

John Hall and Sons, Ltd., announce a profit balance of £8885. Dividends on the preferred ordinary and ordinary (both are privately held) remain the same. Carry forward, £3785 (£4989).

New Companies Registered

Sure Death Pest Exterminators, Ltd. (382,304).—Private company. Capital: £1000 in 1000 shares of £1 each. Manufacturers of and dealers in insecticides, vermicides, etc. Subscribers: Anna Atlas; Nancy M. Grundy. Solicitors: Franks, Charlesly and Co., 10 Essex Street, W.C.2. Registered office: 10 Essex Street, W.C.2.

Chemical Transport, Ltd. (328,238).—Private company. Capital: £100 in 100 shares of £1 each. To co-ordinate transport, and particularly the movement of chemicals in bulk, and to carry on the business of carmen, carriers, forwarding agents, packers, etc. Subscribers: Gaston Bastien; Mary A. Gordon. Solicitors: Soames, Edwards and Jones, Rhodesia House, 429 Strand, W.C.2.

Synthetic Processes and Patents, Ltd. (382,380).—Private company. Capital: £1000 in 1000 shares of £1 each. Synthetic rubber and plastic manufacturers, makers of and dealers in plastics, rubber and synthetic rubber articles, and chemicals and solvents necessary for the production of synthetic rubber and plastics, etc. Subscribers: Alexander Johnston; Geo. A. Findlay; John L. Cornfoot. Registered office: 204 Tottenham Court Road, W.1.

Chemical and Allied Stocks and Shares

THE volume of business passing in the stock and share markets was again only moderate in most sections, but the undertone generally was satisfactory. The tendency to await the next important phase of the war

was again given as the explanation for the absence of improvement in demand. Sentiment was, however, assisted by the small amount of selling in evidence, and many industrial shares continued to hold the greater part of the gains shown in recent weeks.

In accordance with the general tendency, movements in shares of chemical and kindred companies were small on balance for the week. Turner & Newall were 79s. 6d. compared with 80s. 3d., while British Plaster Board have been maintained at 28s. at the time of writing, and Associated Cement at 64s. Imperial Chemical were 38s. 9d., compared with 38s. 10½d. a week ago, and Goodlass Wall 10s. ordinary continued to change hands around 16s. B. Laporte transferred up to 78s. 9d. at one time. Fisons were quoted at 52s. 6d. Lever & Unilever were better at 37s. 9d. The current assumption is that the forthcoming results of the last-named company are likely to show that the dividend is again to be limited to 5 per cent. As in the case of many other leading industrial shares, however, the price is influenced at the present time more by the hope of restoration of the rate of dividend after the war than by the small yield shown on the basis of the current dividend. United Molasses improved from 31s. 6d. to 32s. Moreover, following an earlier small decline, the units of the Distillers Co. rallied to 87s. 3d., the same as a week ago.

Among shares which continued to be governed mainly by hopes of recovery in earnings and dividends after the war, General Refractories 10s. ordinary further improved from 17s. 7½d. to 18s. 1½d., Triplex Glass from 37s. 1½d. to 37s. 7½d., and Wall Paper Manufacturers deferred from 41s. 9d. to 42s. 9d. Moreover, Barry & Staines at 44s. 6d. were well maintained on balance, as were Nairn & Greenwich at 68s. 1½d., while British Oxygen improved moderately to 77s. 6d., and British Aluminium to 50s. Textile issues were less active, but in most cases recent gains were held. Awaiting the financial results, Calico Printers have kept at 16s. 6d. at the time of writing, and the preference units at 20s. Bradford Dyers remained at 22s. 6d. British Celanese 10s. ordinary again showed a tendency to fluctuate, but on balance improved from 33s. 4½d. to 34s. Courtaulds were 55s. 3d., compared with 56s. a week ago.

Among iron and steel issues, Stewarts & Lloyds were 52s. 4½d., Tube Investments 92s. 3d., United Steel 24s. 6d., Staveley 53s. 6d., Dorman Long 26s. 10½d., and Guest Keen 34s. Elsewhere, W. J. Bush remained firmly held and were again quoted at 53s. 9d. The yield on the latter is small on the basis of the 10 per cent. dividend, which has ruled in recent years; but it is realised that earnings on the shares last year were more than twice this rate. The conservative distribution of profits has built up a strong financial

position, and the market is hopeful that more liberal dividends may be forthcoming after the war. Greiff-Chemicals 5s. ordinary were around 7s. 3d., Monsanto Chemicals 5½ per cent. preference 23s. 6d., and Burt Boulton ordinary 19s. Lawes Chemical were 12s. In other directions, Boots Drug 5s. ordinary have been maintained at 43s. 9d., while Sangers were 23s. 1½d. and Timothy Whites improved to 31s. 6d. Among shares of companies with interests in plastics, British Industrial Plastics 2s. shares were higher at 7s. 1½d. and awaiting the financial results. Erinoid 5s. ordinary have been maintained at 12s. 6d. Thomas De La Rue were 153s. 9d., and Lewis Berger 92s. 9d. In other directions, Southalls (Birmingham) changed hands around 34s. 6d. Gas Light & Coke ordinary were 19s. 6d. Oil shares were inclined to improve; at the time of writing, Shell have risen to 80s. 7½d.

British Chemical Prices

Market Reports

THERE has been little change in conditions on the London chemical market during the past week, the demand for the leading industrial chemicals continuing on a substantial scale, mostly against existing contracts. New buying generally, has been of limited dimensions while rather more export activity has been noticeable, particularly in the coal-tar products market. The manufacturers' prices for cream of tartar and tartaric acid have been reduced, the new rates being cream of tartar, 262s. per cwt. less 2½ per cent. in single cwt. kegs, and tartaric acid 3s. 1½d. per lb. less 5 per cent. in cwt. lots. There have been no important price alterations elsewhere and values throughout remain steady with a firm undertone. Good deliveries are reported from most of the soda compounds and available parcels of potash compounds are readily taken up by consumers. Formaldehyde is in good call-and a steady trade is passing in the lead oxides, arsenic and most of the heavy acids. In the coal-tar products market the supply position is of chief interest, most items being fairly well booked. Pitch continues to enjoy a steady if only moderate inquiry.

MANCHESTER.—With less actual interference with market operations because of holiday stoppages at textile and other using establishments in Lancashire, there has been more buying interest in evidence on the Manchester chemical market during the past week, although most of the leading users are already fairly well covered for supplies under contracts. So far as the general run of soda compounds and other bread-and-butter lines are concerned, these are being drawn against fairly steadily and replacement business is being placed as the need arises. Potash

chemicals generally are in short supply and parcels are being steadily absorbed as they become available.

GLASGOW.—In the Scottish heavy chemical trade there is no actual change during the past week, home business maintaining its steady day-to-day transactions, while export trade remains rather restricted. Prompt delivery is getting more difficult. Prices remain very firm.

Latest Oil Prices

LONDON.—August 28.—For the period ending September 25, per ton, naked, ex mill, works or refinery, and subject to additional charges according to package and location of supplies: COCONUT OIL, crude, £49. PALM KERNEL OIL, crude, £48 10s. COTTONSEED OIL, crude, £52 2s. 6d.; washed £55 5s. 6d. GROUNDNUT OIL, crude, £56 10s. LINSEED OIL, crude, £50. RAPESEED OIL, crude, £60. CASTOR OIL, crude firsts, £92; crude seconds, £90. PALM OIL, softs, £42 5s. HERRING OIL, crude, £51 10s. SPERM OIL, crude heads, £85. WHALE OIL, crude hardened, 42 deg., £51 10s. ACID OILS—Coconut and palm kernel, £43 10s.; cotton, black grease, £26; cotton, ex-washed oil, £39; groundnut, £40; sunflower and soya, £38; whale oil, £39, whale oil hardened £41 5s.; palm oil, £36 10s.; tallow, £41; mixed soft, £40; vegetable oil residues, £25; linseed, £40.

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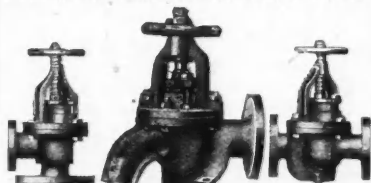
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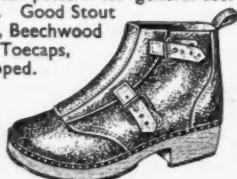
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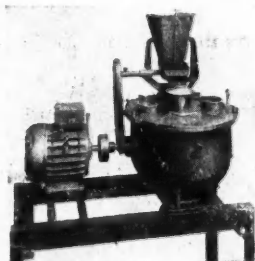
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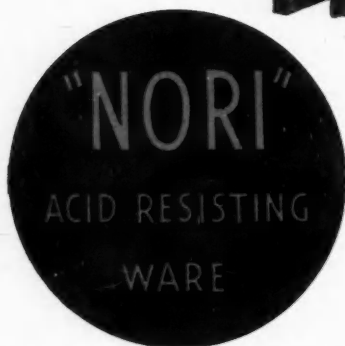
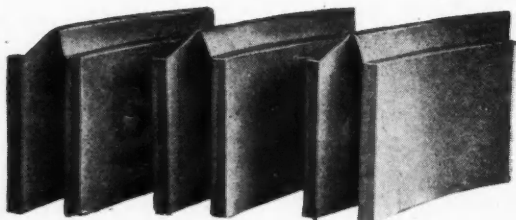
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